# USAF Modeling Updates

16<sup>th</sup> Weather Squadron Advancements in Providing

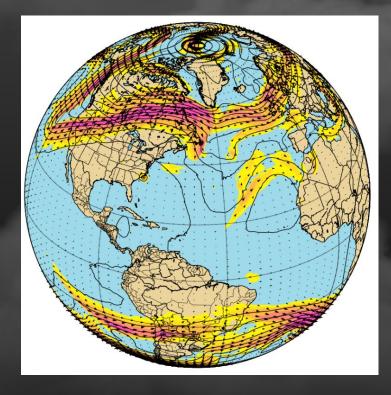
Actionable Environmental Intelligence for Unique Air

Force and Army Mission Requirements





Mr. Evan Kuchera
On Behalf of
16th Weather Squadron

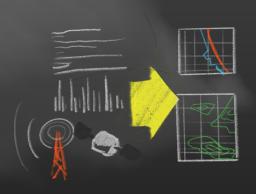


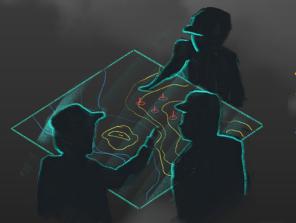
## Mission / Vision

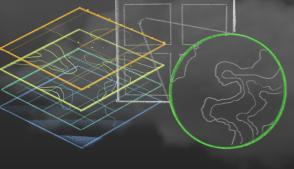


#### Mission

Rapidly innovate, exploit, and operate cutting-edge software applications to generate environmental and Information Warfare insights to support national interests







#### Vision

A high performing team empowered to take calculated risk to solve problems, accelerate change, and bring the future faster



# Current Global Capabilities



## Global Air-Land Weather Exploitation Model (GALWEM)

- USAF version of Unified Model
- Operational since 2016
- Current configuration (OS3) based on UKMO OS41
  - UM 10.9; N768 (17 km)
  - Runs 4x per day (240h)
  - NEW: Running from UKMO generated analyses, no longer doing DA locally

# Global Ensemble Capabilities



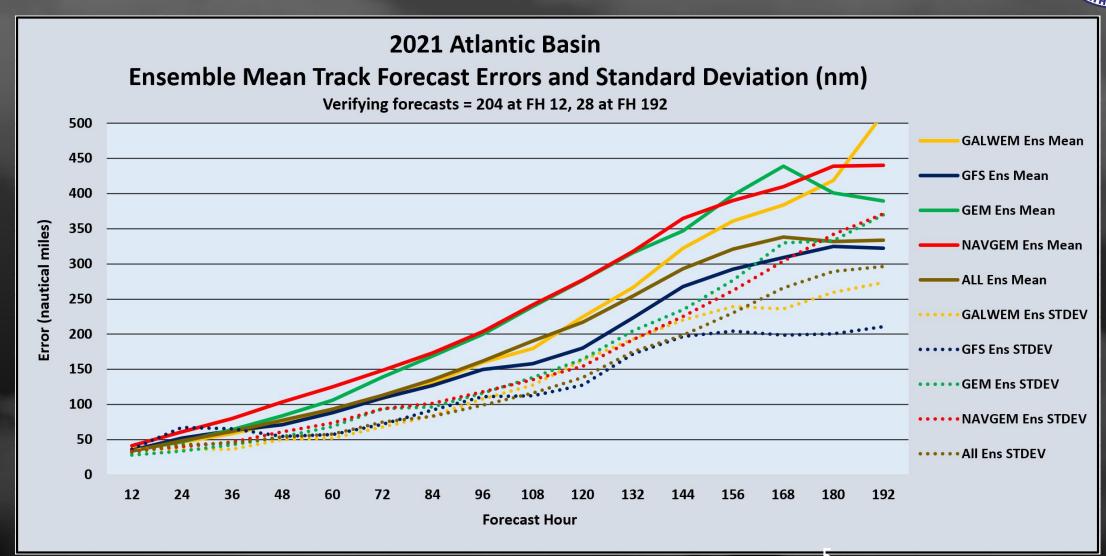
### Global Ensemble Prediction Suite (GEPS)

- 63 members from NCEP, CMC, FNMOC
- Tailored products specific to USAF needs
- 2x daily to 16 days

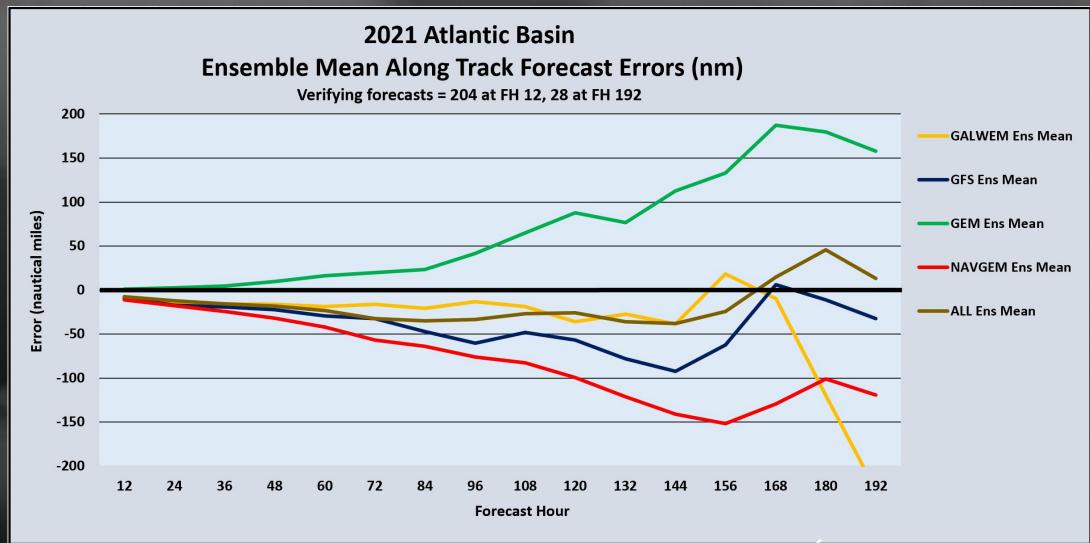
### GALWEM Global Ensemble (GE)

- 21 members at 40 km (half-degree output) run at 557 WW
  - Currently running from local DA, planning to switch to use UKMO inputs
- 16 day forecasts
- Blend in with other 63 in GEPS for improved global ensemble (+4.4%)
- Generate TC tracker bulletins for each member

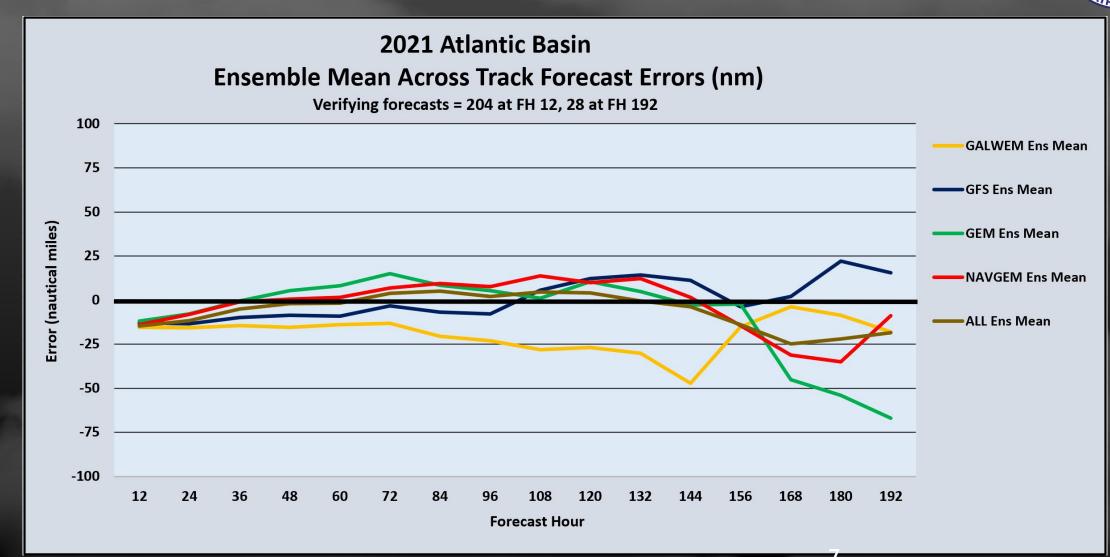
## 2021 Atlantic Basin Track Verification Summary



## 2021 Atlantic Basin Track Verification Summary

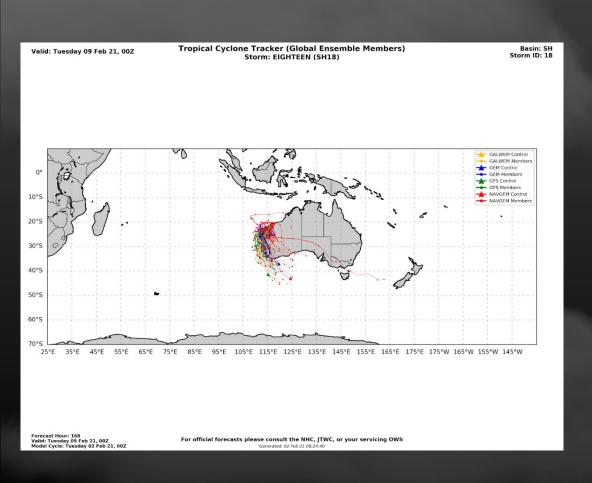


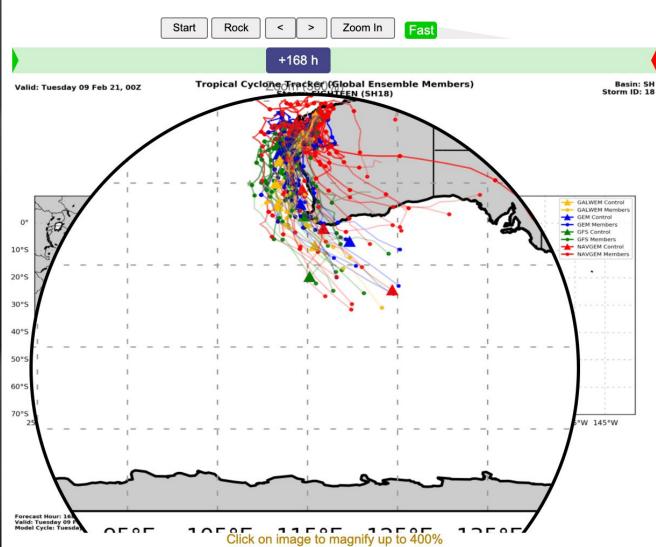
## 2021 Atlantic Basin Track Verification Summary



# TC tracker products







## 5-day smears in GEPS

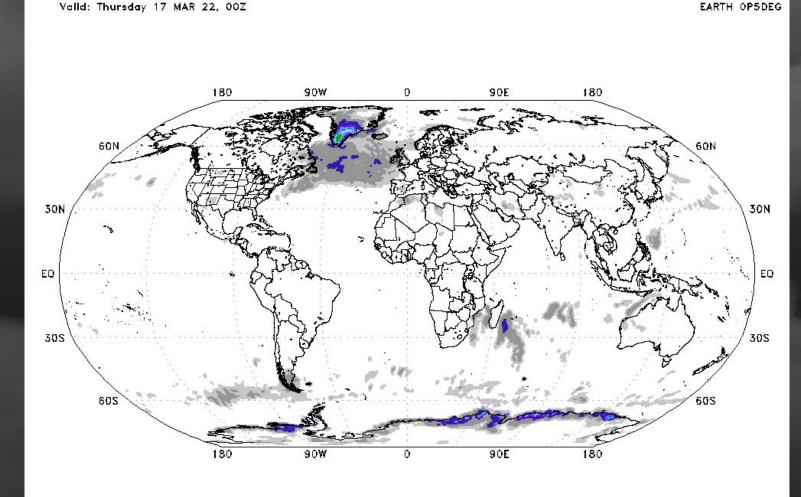
288hr Forecast

Valid: Thursday 17 MAR 22, 00Z Model Cycle: 05 MAR 22, 00Z



Probability of exceeding 34, 64, and 96 knots in the previous 120 hours

Designed for long-range forecasts where timing/location uncertainties are high, to better show areas of TC potential



Probability of SFC Winds >= 64kt over 120 hours

# Regional Capabilities



#### Mesoscale Ensemble Prediction System (MEPS)

- 16 members of WRF-ARW with diverse initial conditions and varied physics packages (Time Lagged)
- "Global" at 20 km resolution (to 144h)
- Regional at 4 km (to 72h) and I km (to 30h)
- Domains moved/modified frequently as mission needs dictate
- ~130M product views last 365 days from 10K unique users
- For the tropical challenge—4 km ensemble provides detailed specifics on local impacts, beyond what storm center/max wind products provide

# Regional Capabilities



Select a model GEPS	201	km l	ME	PS	4kn	n MI	EPS																																				
Enter an ICAO										Sub	Submit							SEMR	How to							to use this product																	
Select a time																																											
LANGLEY AFB MODEL BOX INFO		37.0800 lat 37.0806 lat								×100	-76.3600 lon -76.3594 lon								eters elevation						MAROON: >15% increase in last 12 hours BLUE: >15% decrease in last 12 hours																		
4 km MEPS AUG 03/12Z 2020					N 03															UE 0																							05
Surface winds	16	17	18	19	20	21	22	23	0Z	01	02	03	04	05 (	)6 (	)7 O	_	09 1			2 13	14	15	16	17 1							Z 01	02	03	04	05	06	07	08	09	10	11	12
Wind Gusts GT 25 KT	0	10	8	17	32	8	3	0	0	4	1	0	0	6	5	2 :		32 3		100					66 5	6 4	7 3	5 31	22	2 16	10	5 10	9	9	6	2	0	0	0	0	0	0	0
Wind Gusts GT 35 KT	0	0	0	6	11	0	0	0	0	0	0	0	0	0	0	0 (	)	4 1				_				3 2			10	9	3	2	5	4	0	0	0	0	0	0	0	0	0
Wind Gusts GT 50 KT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0 (	) (	0 0	0 18	_	15	13	17	13	10 1		2 (		3	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Wind Gusts GT 65 KT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0 (	) (	0 0	0 6		2	1	3	1		5 5		_	~		0	0	0	0	0	0	0	0	0	0	0	0	0
LLWS GT 30 KT	0	0	0	0	2	0	0	0	0	0	0	0	1	4	7	9 1	2 1	18 1		THE RESERVE	THE RESERVE		-			_	9 1				2	0	7	7	0	1	3	2	0	0	0	0	0
SUS XWND GT 15 KT RWY:26	0	8	1	10	11	3	2	1	0	3	2	0	0	8	1	1		2 5				45	-		18 1	4 2	1 9		2 6		0	0	6	0	0	0	0	0	0	0	0	0	0
SUS XWND GT 25 KT RWY:26	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0 (	) (	0 0	0 6	-	and the last	100	16	-	Service Co.	9	3	9		_	0	0	0	0	0	0	0	0	0	0	0	0	0
SUS XWND GT 35 KT RWY:26		0		0	0	0	0	0	0	0	0	0	0	0	0	<u> </u>		0 0			4		4		3	-0.0	(	) 4			0	0	0	0	0	0	0	0	0	0	- 4	0	-
Precipitation					20	21	22	23	0Z	01	_		-		)6 (		8 0	09 1	0 11	1 12	2 13	14	15	16	17 1	8 1				2 23	-		02			05	06	07	08	09	10		
Precip GT 0.05 IN in 6 hr	100	-99	-		62	68	69	67	73	68	63	39	32	27 2	27 3	33	4 7	9 8	0 85	5 87	87	87	87	80	84 8	0 7	2 4	7 47			32	2 32	2 20	13	13	7	0	0	0	0	0	0	0
Precip GT 2.0 IN in 12 hr	-99	-99	-99	-99	-99	-99	-99	-99	3	3	3	3	3	1	1	0 (	) (	0 0	) 0	0	3	4	4	4	4	4 4	4 4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FZRA GT 0.01 IN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0 (	) (	0 0	) 0	) 0	0	0	0	0	0	0 (	) (	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SN GT 0.1 IN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0 (	) (	0 0	) 0	0	0	0	0	0	0	0 (	) (	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SN GT 2.0 IN in 12 hr	-99	-99	-99	-99	-99	-99	-99	77	0	0	0	0	0	0	0	0 (	) (	0 0	) 0	0	0	0	0	0	0	0 (	) (	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SN GT 6.0 IN in 24 hr	-99	-99	-99		-99				-99		-99	-99 -	-99 -	99 -	99 -	99 -9	19 -9	99 -9	9 -9	9 0	0	0	0	0	0	0 (	) (	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Thunderstorms	-	17	18		20		and the same of	23	0Z		and the same of	03	04	05 (			_	09 1		1 12		14	15	10		8 1			-	2 23	02	Z 01	02	03	04	05	06	07	08	09	10	11	12
Lightning within 20 NM	25	52	55	59	42	47	22	4	10	16	18	7	10	7	6	6 1	3 2	21 3	6 40	0 31	27	25	18	14	20 1	4 1	1 1	5 9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.0 IN Hail within 20 NM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	) (	) (	0 0	) 0	0	0	0	0	0	0	0 (	) (	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.0 IN Hail within 20 NM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	) (	) (	0 0	) 0	0	0	0	0	0	0	0 (	) (	0	0	0	0	0	0	0	0	0	0	0	0	0	_	0	_
Tornado within 20 NM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	) (	) (	0 0	) 1	4		0	0	0	0	0 (	, ,	0	0	0	0	0	0	0	0	0	0	0	0	0	-	0	
Cig + Vis	16	17	18	19	20	21			0Z		~-		04		, ,		8 0								17 1					_	02	Z 01	02	_		05		٠,			10		
Visibility LT 5 miles	0	7	19	10	18	8	6	10	19	21	7772		24	29	18 2	5 2		30 4	1000		-	-	The same of the sa	-	19 1				8	Bernann	9	7	5	10						44	49	585	10 m
Visibility LT 3 miles	0	7	13	5	13	7	1	6	5	5	12	16	5	9	5	5 4	7	9 2:			2 6		5	-	11			10			3	1	1	2		10000	11	16	19	20	23	15	17
Visibility LT 1 mile	0	2	1	0	2	0	0	0	0	0	2	1	0	0	0	0	)	0 3	3 0	0	0	0	0	0	1	0 (		0	THE REAL PROPERTY.		-			0	0	0	0	1	1	1	1	1	1
Ceiling LT 3000 ft	31	18	25	13	24	33	32	52	49	35	19	36	26	22 [2	28 2	8 7	2 3	33 5	4 6	8 7	71	75	74	80	57	59 5	_	2 34		1 31			5 11	11	11	9	6	3	1	5	4	8	7
Ceiling LT 1000 ft	4	7	1	1	9	1	2	10	8	4	7	8	4	3	4	5 1	3	4 8	3 8	11	14	19	20	16	10	9 1	2 1	3 10	) 5	9	13	8	4	2	1	1	2	1	0	2	2	6	3
Ceiling LT 500 ft	0	3	0	0	3	0	0	2	1	0	1	1	0	0	0	1	2	0 1		1	1	2	3	2	1	1 1		1	1	2	2	1	0	0	0	0	0	0	0	0	0	2	1
Others	16	17	18	19	20	21	22	23	0Z	01	02	03	04	05 (	)6 (	7 0	8 0	19 1	0 1	1 12	2 13	14	15	16	17 1	8 1	9 2	0 21	22	2 23	02	Z 01	02	03	04	05	06	07	08	09	10	11	12
Mean Temperature (F)	88	86	85	84	82	82	82	81	80	79	79	78	78	78 '	78 7	7 7	8 7	/8 7	8 78	8 77	76	76	77	78	79 7	9 8	1 8	1 81	81	80	78	3 77	76	76	76	75	75	74	74	73	73	74	77
Mean Wind Speed (KT)	8	8	8	9	8	7	6	6	6	6	6	5	5	7	7	7 9	) 1	10 1	2 16	6 18	3 17	20	21	18	17 1	8 1	4 1	2 12		10	~	7	8	7	7	6	6	6	5	5	5	4	5
Prob GT 80% Cloud Cover	69				83	95	94		95		86	86	87		38 9	15 9	7 9	98 9	8 98			97	93	90			0 5	7 56	53	3 34			3 15	17	19	17	12	8	9	12	5	10	
Station Adj ALSTG			3005					ľ	3004					2	999					297	7				29	82					298	37					2996					2	3002

### Plans



- Capability migration to new supercomputer at Oak Ridge National Laboratory
  - GALWEM deterministic to 240 hours already there operationally
  - MEPS/GEPS planned operations summer 2022
  - 21 members of GALWEM-GE at 0.25 degree output to 16 days summer/fall 2022
  - Software deployed from GitLab CI/CD pipeline
    - Automated security/quality checks
    - Enables rapid deployment of capability modifications

#### MEPS efforts

- Upgrade WRF to 4.3.3 and utilize increased computing power for more members/more sophistication
- More research on value-added from more members, finer resolution, varied initial conditions, etc.
- Rapid Refresh research OCONUS

#### Cloud efforts

- Utilize scalable resources to move towards a more on-demand regional modeling posture
- Potential for "pay to play" approach to running regional models

# Questions or Comments?



Evan.Kuchera@us.af.mil